

2024 UT Austin Invitational Science Olympiad Crime Busters B Exam Packet

October 26th, 2024



Names: _____

Team Number: _____

Parameters:

- Each participant may bring 1 sheet of paper and lab equipment specified in the Science Olympiad official rules.
- Each participant is required to wear proper PPE at ALL times.
- Failure to clean up your station before the conclusion of the 50 minutes will result in a penalty of up to 10%.

Directions:

- You will have 50 minutes to complete this exam.
- All answers must be indicated on your answer sheet.
- Point values indicated for all questions are indicated in test booklets.
- The maximum number of obtainable points on this exam is 206.

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Any questions after the conclusion of the event can be directed to aivyvy@utexas.edu

The Missing Berry

In the tranquil town of Pallet, a mystery unfolded that sent a shock through the Pokémon community. The annual Berry Festival was just days away, and everyone was excited to celebrate with the prized Golden Berry: a rare fruit said to enhance a Pokémon's abilities. However, disaster struck when the Golden Berry went missing just before the festival. Detective Pikachu, renowned for his sharp instincts and deductive skills, was called in to investigate.

As Detective Pikachu arrived at the scene, he surveyed the area around the Berry Garden, where the Golden Berry had been displayed. The theft had left a sense of unease, and Pikachu was determined to uncover the truth.

Detective Pikachu began his investigation by questioning all the Pokémon in the area, starting with Bulbasaur, who had been tending to the garden that morning. Next, he turned to Squirtle, who claimed to have been swimming in a nearby pond. Eevee stated it had been playing in the grass during the same time, chasing around the wild Butterfree. Pikachu then approached Charmander, who stated it had been practicing fire moves in a distant training area. Finally, he questioned Ditto, who claimed to be practicing transformations. As Pikachu spoke with each Pokémon—Bulbasaur, Squirtle, Eevee, Charmander, and Ditto—he remained attentive to their alibis, motives, and the subtle signs that might indicate whether any of them had been involved in the theft of the Golden Berry.

After gathering the alibis and motives, Detective Pikachu returned to the Berry Garden to reflect on the clues. Each Pokémon had a plausible reason to desire the Golden Berry, but who could have pulled off such a heist?

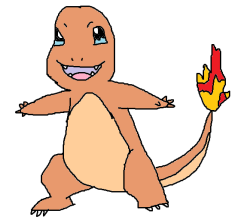
Pikachu followed a faint trail that led away from the Berry Garden, discovering remnants of crushed berries along the path. The trail led him to a hidden thicket where the culprit must have fled off to after the crime. The further he ventured, the more he noticed signs of a hasty attempt to cover their tracks.

When Pikachu arrived at the thicket, he found the Golden Berry hidden beneath a pile of leaves. Surrounding it were signs of a recent feast, including bits of leaves and berry juice stains. It was evident that someone had enjoyed their ill-gotten gains.

Returning to the Berry Garden, Pikachu laid out the evidence and asked for your help to solve the crime. Help Pikachu find the culprit of the missing Golden Berry and bring justice to Pallet Town.



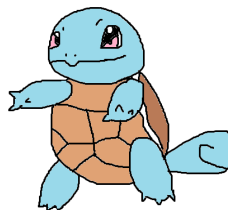
Bulbasaur



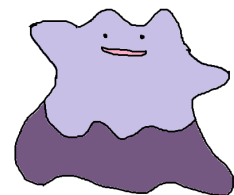
Charmander



Eevee



Squirtle



Ditto

Pikachu's Notebook

Bulbasaur

- Alibi: I was busy tending to the garden nearby for the festival. Squirtle must have seen me watering all the plants since they helped me with getting water. After watering the garden, I went inside to help prepare the cake for the ceremony, but we ran out of batteries for the scale! I went to the store after and came back to see the golden berry was gone!
- Bulbasaur is a small, amphibian and plant Pokémon that moves on all four legs.

Charmander

- Alibi: I was practicing my fire moves on the training grounds! I am one of the performers for the ceremony and wanted to have a grand finale. I didn't see anyone today but I returned to my Pokéball to wash up after getting dirty from all the sand on the training grounds. I just tried this new electrolyte drink that's supposed to be ultra-hydrating, want to try some?
- Charmander is a bipedal, reptilian Pokémon.

Eevee

- Alibi: I was playing with the Butterfree! They recently came back into town and I wanted to have fun! I didn't do anything to help with the ceremony so I didn't see anyone else. I do remember Ditto calling me out for help with Eeveelutions, but I couldn't help that much...
- Eevee is a small, mammalian quadrupedal Pokémon with primarily brown fur.

Squirtle

- Alibi: I was swimming in one of the ponds when Bulbasaur asked me for help. I went to help Bulbasaur water the plants and completely forgot I was on kitchen duty! I asked Bulbasaur to help me but they weren't very helpful. I had to make the entire cake by myself!
- Squirtle is a small, light-blue Pokémon with an appearance similar to a turtle.

Ditto

- Alibi: I was practicing my transformations in the field next to Charmander! We are performing during the opening and closing ceremonies, but I wanted to make it great! I was having some trouble with the Eeveelutions and went to ask Eevee if they could help me. They weren't of much help so I went to the kitchen to help, but Bulbasaur was already done baking the cake! I ended up just helping the clean up process.
- Ditto is a light-purple or pink blob-like Pokémon with vestigial facial features.

Squirtle's Strawberry Shortcake Recipe:

Detective Pikachu found this recipe list left in the kitchen! Maybe while travelling through Pallet town you can grab some ingredients and try for yourself!

Whipped Cream Frosting Ingredients

- 1.5 tsp Unflavoured Gelatin
- 30 mL Cold Water
- 550 mL Heavy Whipping Cream
- 90 g Powdered Sugar
- 1.5 tsp Vanilla Extract

Whipped Cream Instructions

1. In a microwave-safe bowl, whisk together gelatin and cold water until dissolved.
2. In a separate bowl, combine heavy cream, powdered sugar, and vanilla extract until thickened.
3. Microwave the hardened gelatin mixture for 5 - 10 seconds.
4. Combine the gelatin mixture with the cream mixture and whisk until stiff peaks form. The peaks should be able to stand upside down.
5. Cover with plastic wrap.
6. Set aside in the fridge until the cake assembly.

Cake Assembly:

1. Once the cakes have been cooled, level them as you see fit.
2. Place your first cake layer down and spread an even layer of whipped cream.
3. Lay your canned strawberries on top of the layer of whipped cream.
4. Top the strawberry layer with more whipped cream.
5. Repeat the steps with each layer of cake.
6. Add decor to the top of the cake and enjoy!

Cake Ingredients

- 375 g Flour
- 300 g Granulated Sugar
- 250 g Unsalted Butter
- 3 Eggs
- 1 tbsp Baking Powder
- 1 tsp Salt
- 300 mL Buttermilk
- 3 Cans of Strawberries

Cake Instructions

1. Preheat oven to 175C and three 8" cake pans.
2. In a bowl, cream your butter and sugar until creamy.
3. One at a time, add each egg, stirring well after each egg.
4. Add vanilla extract.
5. In a separate bowl, combine flour, baking soda, and salt.
6. Alternate between adding the dry mixture and buttermilk to the wet mixture. Incorporate each well, but do not over-mix.
7. Divide the batter between the three pans and bake for 24 - 26 minutes.

Qualitative Analysis (TB2)

1. (50 points) Using the samples provided, fill out each powder's respective chemical formula, name, and one applicable connection between this powder and the story. Mixtures indicated with an asterisk*

Powder #	Chemical Formula (2) Write NA if not applicable	Powder Name (2)	Application in Story (1)
1*			
2*			
3			
4			
5			
6			
7			
8			
9			
10			

2. (10 points) Using the samples provided, fill out each metal's name, use in daily life, and one applicable connection between this metal and the story.

Metal #	Metal Name (2)	Use in Daily Life (1)	Application in Story (2)
1			
2			

3. (15 points) Using the samples provided, fill out each liquid's name, use in daily life, and one applicable connection between this liquid and the story.

Liquid #	Chemical Formula (1)	Liquid Name (2)	Application in Story (2)
1			
2			
3			

4. (2 points) Write the complete, balanced chemical reaction between sodium bicarbonate and hydrochloric acid. Include states of matter.
5. (1 point) Why is HCl considered a strong acid?
6. (2 points) Why does heat oftentimes increase the solubility of a compound?
7. (1 point) What does anhydrous mean?
8. (1 point) Bleach _____ melanin in human hair to change its colour.
9. (2 points) Reduction is a(n) _____ of electrons while oxidation is a(n) _____ of electrons.
10. (4 points) Identify the oxidation agent, reducing agent, and oxidation numbers in the following reaction:
 $MnO_4^- + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+}$
11. (2 points) Hydrogen Peroxide acts as a(n) _____ to breakdown the _____ molecules in blood, allowing it to "wash-out" of stained clothing.
12. (2 points) In which phase of hair growth do hairs not grow? Give an estimate to how long this phase lasts.
13. (2 points) Nitrogen fixing bacteria convert _____ into _____.
14. (2 points) Explain why iron is magnetic but aluminum is not.

15. (2 points) Static electricity is the result of an imbalance of positive and negative charges, but unlike current electricity, remains stationary until discharge. Name two factors that may impact its increased prevalence in the winter compared to the summer.
16. (2 points) The combination of yeast, flour, and water result in the process of _____. This process _____ require oxygen.

Polymer Testing/Natural and Man-made Substances (TB3)

17. (6 points) Using the information found in your image sheet, fill out the table with each plastic's respective information.

Plastic #	Abbreviated Name (1)	IUPAC ID(1)	Formula (1)
1			
2			

18. (2 points) Name two differences between the two plastics.

19. (8 points) Using Figures 1 and 2, found in your image sheet, fill out the table with each fiber's respective information.

Fiber #	Organic/Synthetic (2)	If organic, animal or vegetable? If synthetic, write "NA" (1)	Application in Story (1)
1			
2			

20. (4 points) Using Figures 3 and 4 in your image sheet, fill out the table with each hair's respective information.

Fiber #	Identify the species of hair (1)	Application in Story (1)
1		
2		

Chromatography

21. (10 points) Charmander left you three samples of their electrolyte drink! Use the provided samples to create 3 chromatography sheets. Staple these to the **FRONT** of your final exam. Label with your team number in pencil.

Crime Scene Physical Evidence

.5.5.5

22. (5.5 points) Detective Pikachu identified parts of some fingerprints left at the crime scene. Label each of these fingerprint characteristics using Figure 7 in your image sheet. Some terms may or may not repeat.

A:

B:

C:

D:

E:

F:

G:

H:

I:

J:

K:

.5.5.5

23. (1.5 points) Where are the three regions from which a fingerprint begins to develop?
24. (2 points) Detective Pikachu dusted surfaces at the scene of the crime. What type of print is this? What allows for this visualization?
25. (2 points) The soil at the crime scene was found to have contained 35% silt, 30% sand, and 35% clay. Identify the soil classification.

26. (1 point) What is the ideal pH of soil for plant growth?
27. (2 points) What are the three components of a soil's mineral fraction?
28. (2 points) Detective Pikachu discovered some blood splatters on the way to the golden berries. Rattata, a rat pokémon, must have bit someone when trying to escape! Describe the direction of movement of blood spatter 1 under Figure 6.
29. (2 points) Using Figures 5 and 6, describe the difference between blood spatters 1 and 2.
30. (5 points) Using Figures 8, 9, 10, 11, and 12, write down each Pokémon's DNA sequence. Assume the right and left sides of the diagram correspond to 5' and 3', respectively.
31. (1 point) Detective Pikachu was able to get a DNA sample from the stolen Golden Berry. Write out the DNA sequence shown on this PAGE Gel. Label 5' and 3' ends.

Analysis (TB1)

32. (52 points) Who committed the crime? Include all relevant information. Cite motives and alibis for each suspect.